WORKING PLAN

Pilot Test of Three Insecticides for Preventing Attacks of the Mountain Pine Beetle in Lodgepole Pine

February, 1975
by William H. Klein

INTRODUCTION

During the past two decades, the mountain pine beetle, Dendroctonus ponderosae Hopkins, has seriously depleted lodgepole pine stands throughout most of the host type in the Intermountain Region. In some areas upwards of 40 percent of the trees and 60 percent of the merchantable volume have been killed. Attempts at control, utilizing individual tree treatment with insecticides, piling and burning, and logging, have been largely unsuccessful.

There now exists an unprecedented opportunity for salvaging and utilizing much of the dead material and refining many of our management techniques for lodgepole pine. The mountain pine beetle population, although on the decrease Regionwide, is still active in many areas. Tree losses will continue to accumulate, but it is unlikely that we will ever commit ourselves to large-scale control programs--at least not until more effective control methods are developed. Losses in wild stands are difficult to accept but recognized as inevitable in most instances. However, the loss of high-value trees in recreation areas and developed sites is particularly difficult to accept when some degree of protection is not only possible but practical.

Insecticides, when applied at diluted concentrations on the bole of trees, can prevent attacks by bark beetles, thus saving the tree for an indefinite period of time. Lindane, for example, is effective in preventing attacks by the western pine beetle, Dendroctonus brevicomis LeConte in ponderosa pine (Swaine, 1965). During an extensive field test, Lindane, Sevin, and Dursban deterred attacks by the mountain pine beetle in lodgepole pine in California and Idaho and in ponderosa pine in Colorado (Smith, McCambridge and Trostle, 1975). The need now is to test these promising preventive treatments under operational conditions.

PURPOSE

The purpose of this pilot test is to determine the efficacy of three oil-formulated chemicals, Lindane (2%), Sevin (2%), and Dursban (2%),

in protecting lodgepole pine from being attacked by mountain pine beetle adults under operational conditions. A secondary but nonetheless important objective will be to obtain meaningful treatment and cost data as a basis for subsequent benefit-cost analyses.

AREA

The treatment area will be the Buffalo Campground on the Targhee National Forest near Island Park, Idaho (Figure 1). In this area, mountain pine beetle populations are high and can be expected to exert heavy pressure and additional tree mortality in and surrounding the campground. Table 1 shows the present infestation level in Buffalo Campground and six other nearby campgrounds (Stipe, 1975, Biological Evaluation Report attached).

METHODS

This pilot test will entail treatment of three separate 200-tree groups of lodgepole pine with 2% formulations of three insecticides, Lindane, Sevin, and Dursban, each diluted with #2 fuel oil. A tabulation of treatments follows:

		Number of Lodgepole Pines		
No.	Formulation	Treated	Checks	Total
1	2% Lindane in oil	200	>200	>400
2	2% Sevin in oil	200	>200	>400
3	2% Dursban in oil	200	>200	>400
	Total	600	>600	>1200

Tree Selection

All trees will be 9.5 inches d.b.h. and larger, and all check trees will be within ± 2 inches d.b.h. of their companion treatment trees. In order to assume that there will be equal beetle pressure on both treated and check trees, treatment trees will be separated from each other by a distance of at least one-half chain (33 ft.), and all potential check trees will be within a one-half chain radius of their companion treatment tree (Figure 2). Each treatment tree and all untreated check trees within ± 2 inches d.b.h. and 33 ft. radius will be considered a treatment cluster (Figure 1). It will be possible, then, to have a minimum of 1 to a maximum of perhaps 10-12 check trees. Ideally, the overall ratio between treatment and check trees should average 1:5.

All treatment trees will be located and marked sometime prior to June 1, 1975. Trees will be consecutively numbered (1 to 200) and marked with two metal tags, one at ground level and the other at the seven-foot level. A rough stand map will be made to relocate treatment trees in the event tags are mutilated or removed.

Spray Formulation and Application

The insecticides and fuel oil spray will be formulated on site, mixed by agitation, and kept in suspension by a recirculating pump system. Immediately following each treatment, the mixing and holding tank, pump unit, and spray equipment will be flushed with Nutra-sol. Flushing of equipment will be done at an approved pesticide dumping site.

Spray will be recirculated and pumped by a pickup-mounted, low-pressure spray system of at least 100-gallon capacity. Spray will be applied directly to the bark by a nozzle attached to a 20-foot metal wand or to a light-weight plastic hose attached to the head of a 25-foot telescopic pole system. Before the spray is applied, tree boles will be completely dry.

All treatments will be completed by July 1, well before the start of beetle flight. Spray application will be at the rate of approximately one gallon per 50 square feet of bole surface. A tabulation of bole surface area to 25 feet in height by diameter class and the amount of spray required follows:

	Tree Diameter (d.b.h.) in Inches				
	10	12	14	16	18
Area ($Ft.^2$) 1/	60	72	85	95	108
Spray Required (gallons)	1.21	1.43	1.70	1.89	2.16

1/ Based on measurements of nine trees in the 10-inch class and 18 trees in each of the remaining d.b.h. classes.

All trees, regardless of size, will be treated to a height of 25 feet. Volume of spray will be monitored by an in-line flow meter. Extreme care will be taken to insure complete and even coverage and to minimize drift and/or spillage.

The campground will be closed to the public until one week after the last tree is sprayed.

Insecticides Tested

Lindane, a chlorinated hydrocarbon, is a widely used pesticide, and for forestry application is registered for suppression of the balsam woolly aphid, wood borers in logs, the mountain pine beetle, and the southern pine beetle, to name a few. It is more toxic to warm-blooded animals than Sevin, but only one-fourth to one-tenth as toxic as DDT. When applied to trees at normal dosage levels, no deleterious effects on wildlife have been observed. Lindane is also nonphytotoxic at normal insecticidal dose levels. It is, however, highly persistent in soils, sometimes lasting years, but the persistence of residues varies with the physical properties of the soil and extrinsic influences such as rainfall. It is doubtful that with the dosage and method of application--direct application to the tree's bole--used in this test, there will be any significant environmental damage.

Sevin (Carbaryl), a carbamate, is a product of Union Carbide Corporation and widely used for insect suppression in both agriculture and forestry. In forest use, it is registered against a wide range of insects, including the gypsy moth, tent caterpillars, and elm beetles. It is a contact insecticide of good residual life--about 200 days--and has some systemic properties. It has not evidenced phytotoxicity when applied at normal rates and has a low vertebrate toxicity. It is, however, very toxic to honeybees.

Dursban (Chlorpyrifos-Methyl) is an organicphosphate and a product of the Dow Chemical Company. It is a broad-spectrum insecticide and is currently registered for control of mosquitos, many household pests, aphids, grasshoppers, the Japanese beetle, and ticks, to name a few. It is not registered for control of any forest insects.

Studies have shown that Dursban's low volatility properties result in long retention on relatively porous surfaces such as paper, wood and painted surfaces. In soil, Dursban is relatively stable and long-lived, but degradation increases with increased sunlight, alkalinity (pH) and temperature. In organically polluted waters, mosquito larvae have been controlled for one to three months with 0.1 ppm.

Laboratory studies using animals have shown Dursban to be a cholinesterase inhibitor, but it has not caused any deleterious effects to mammals, including man, when applied at recommended dosages. It has low toxicity to birds and is slightly more toxic to fish. It is phytotoxic to some plants, such as roses and azaleas but nontoxic to others. It is highly toxic to honeybees, as is Sevin.

Evaluation of Treatment Effectiveness

On-the-ground evaluations will be conducted following cessation of beetle flight (Fall) in 1975 and 1976.

An evaluation of treatment effectiveness will be made by direct comparisons between treatment and check trees for each chemical treatment. Comparisons can be made only if (1) the treated tree is attacked, regardless of whether its check trees are attacked or not, or (2) the treated tree is not attacked and one or more companion check trees are attacked. If the treated tree and its check trees are not attacked, then no comparison will be made. The overall strength of the analysis will depend on the total number of comparisons; i.e., the greater the number of comparisons, the more definitive the analyses.

Trees will be regarded as being successfully attacked if they contain sufficient brood to kill the tree. A tree having a strip attack will not be considered as killed unless it succumbs the second year (1976). The untreated portion above the 25-foot limit will be examined by binoculars and verified, if necessary, by climbing the tree.

Comparisons of brood abundance and activity will be made between treated and untreated trees. Successfully attacked treated trees and the nearest attacked check tree will be examined for brood stage, relative abundance, and condition. If no check tree is attacked, then the nearest attacked tree of similar size will be used. If attacks are in the treated portion, number of attacks, gallery length, and brood stage will be recorded by removing two, 6 x 6-inch bark samples from opposite quadrants at d.b.h. If attacks occur above the spray height (25 feet), similar samples will be taken at the 27-foot level.

In the final analysis, it will be important to know the stress exerted on the stand in the treated area by the surrounding mountain pine beetle population. Infestation level and population trend will be estimated from approximately 30, half-acre (1/2 x 10-chain) semi-permanent plots randomly selected throughout a four-square-mile area surrounding Buffalo Campground (Figure 1). The plots will be established and cruised in May 1975, to determine green stand structure and the density of 1973 and 1974 attacks. The plots will then be revisited in the fall of 1975 and again during the fall of 1976 to record 1975 and 1976 attacks.

An effort will be made to determine the various types of bark beetles, wood-boring insects, other bark inhabiting insects, and predaceous insects that may be affected by the treatments.

Catchment nets, surrounding the lower tree bole, will be placed on three treated and three untreated trees in each of the three treatment areas prior to treatment. They will be examined and collected at periodic intervals following spraying. All catches will be preserved in 70% alcohol, dated, and brought to the laboratory for examination and identification at a later date.

Sequence of Activities

A sequence of activities for calendar years 1975 and 1976 follows:

Activity	MONTH							
	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT
Planning	75	75						
Tree Selection			75	75				
Treatment			75	75				
Trend Plots				75			75, 76	
Soil Samples					75	75		75, 76
Insect Coll.					75	75	75	75
Evaluation							75, 76	75, 76

Environmental Concerns

There is a possibility that the oil formulations will cause mild phytotoxicity of tree foliage and other vegetation around the base of some of the treated trees. Care will be taken to minimize runoff and to avoid accidental spraying of portions of the lower crown, but some ground vegetation damage is inevitable.

Paired, semipermanent photo plots utilizing color stereography will be established near every twentieth-treatment tree (20, 40, 60, etc.) and nearby check tree to record the condition of the surrounding vegetation immediately prior to treatment and 10 to 20 days following treatment.

The rate of chemical degradation in the soil surrounding the treated trees will be determined by laboratory anlysis. Samples will be taken from the base of three treated and three check trees from each of the three treatment areas (1) one week before

treatment, (2) one week following treatment, (3) in the fall of 1975, and (4) again in the fall on 1976. Additional samples will be procured from areas exhibiting significant vegetation damage.

Cost Analysis

Records of all costs relevant to the operational phase of the test will be kept. Insecticide and solvent costs, equipment rental costs, and time spent in treatment will be closely compiled and monitored. An overall treatment cost as well as the cost per individual tree will be included in the final report.

Safety

Treating crews will wear protective clothing, including hardhats, goggles and gloves. Hot shower facilities will be available nearby in Ponds Lodge.

Campground tables and water hydrants will be covered with a protective tarpaulin during the spray operation and washed with detergent and water upon completion.

Pesticide Disposal

An attempt will be made to utilize all of the mixed insecticide, but in the event of a surplus, it will be applied to a few additional trees or disposed of in an approved disposal site.

Prepared by: William H. Klein
Entomologist
Forest Insect and Disease Control

Recommended by: Alfred M. Rivas
Director
Forest Insect and Disease Control

Approved by: Marlin C. Galbraith
Deputy Regional Forester
State and Private Forestry

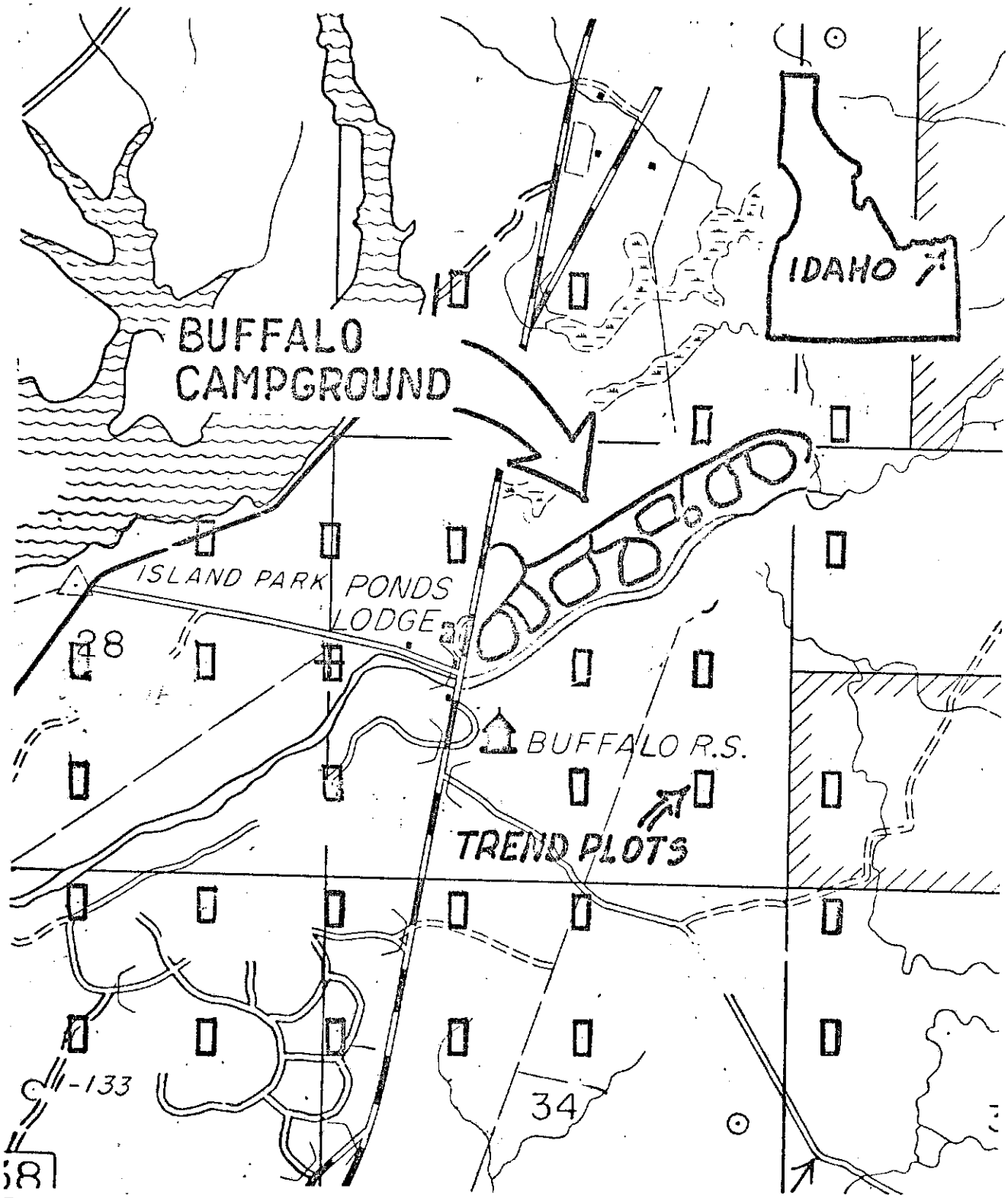

Figure 1. Location of Buffalo Campground (pilot test area) and of systematically chosen one-half-acre trend plots. All plots are within lodgepole pine type.

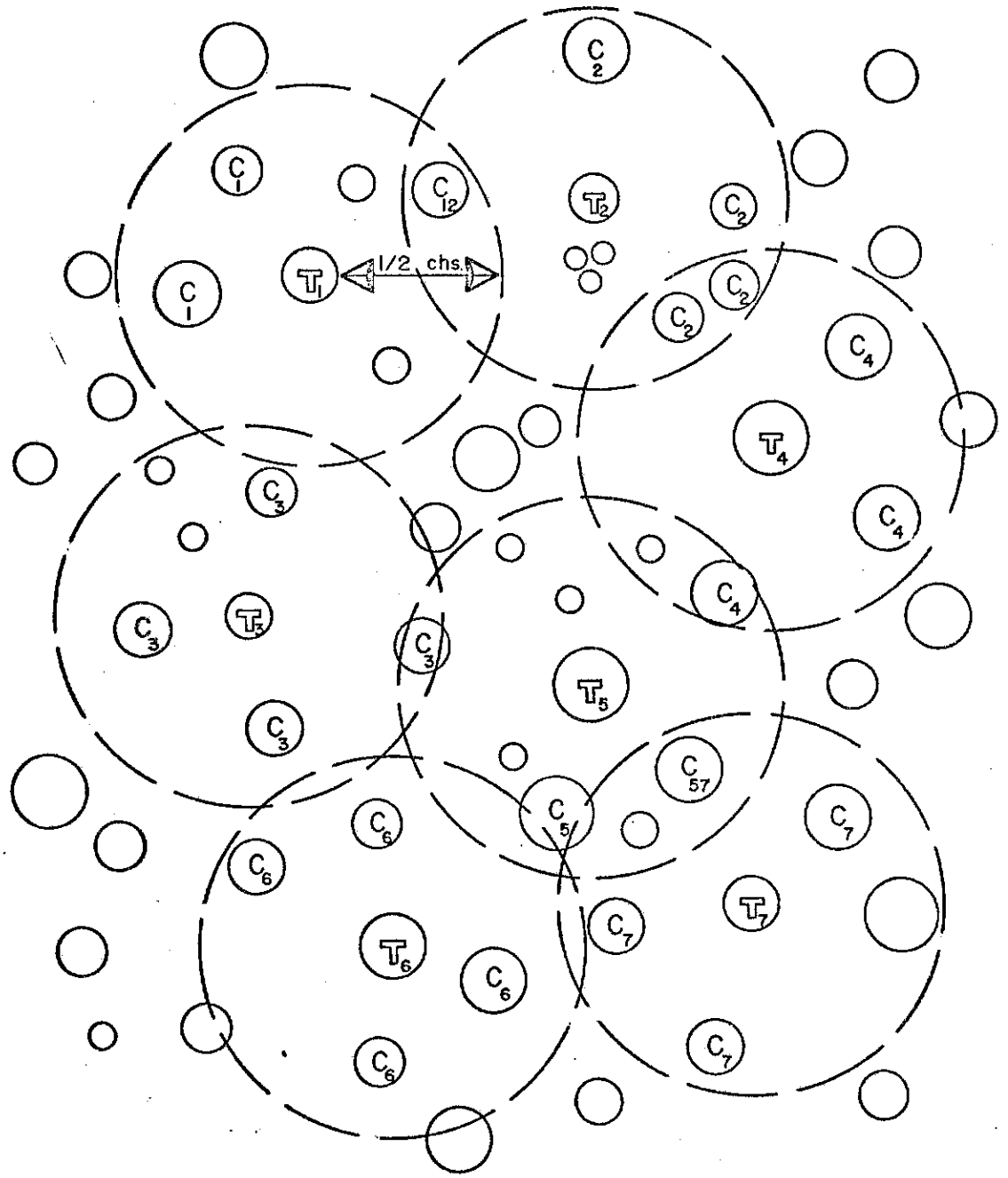

Figure 2. Hypothetical stand map showing arrangement of seven treatment clusters. Treated tree (T) is focus of cluster with check trees (C) within 1/2-chain (33 feet) radius. Trees not designated as checks are beyond 1/2-chain radius of treatment tree, or if within radius, they are either too large (+2" d.b.h.) or too small (-2" d.b.h.). It is possible to have the same check tree(s) (C_{12} & C_{57}) common to more than one treatment tree.

Table 1. Stand structure analysis of seven campgrounds on the Targhee National Forest, November 1974.

	Number of Lodgepole Pine per Acre[1/]							
	Live		1974 MPB Attacks					
Campground	>10"	Total	>10"	Total	Old[2/] Dead	Total Dead	Area in Acres	Total Live >10"
Buffalo	57	129	8	10	36	46	68	3876
Buttermilk	58	113	7	7	20	26	62	3596
Flat Rock	17	190	4	14	21	35	20	340
U. Coffee Pot	33	46	5	7	35	43	7	231
Box Canyon	78	171	20	20	63	84	5	390
Big Springs	83	311	9	15	45	60	8	664
McCrea Bridge	45	104	8	8	49	47	10	450

1/ Other tree species of minor occurrence were recorded but not included in this analysis.

2/ Includes stumps of trees removed for hazard reduction.

Table 2. Cost estimate for preventive spray pilot test - salaries and travel.

		Fiscal Year									
		1975			1976			1977			
Function	Manpower[1/]	Salary	Per Diem	Mileage	Salary	Per Diem	Mileage	Salary	Per Diem	Mileage	Total
Pre-Spray	PFT (5MD)	--	125	100	--	--	--	--	--	--	225
(Trend)	WAE (20MD)	700	500	150	--	--	--	--	--	--	1350
Tree Selection	PFT (20MD)	--	500	100	--	--	--	--	--	--	600
Treatment	PFT (20MD)	--	500	100	--	--	--	--	--	--	600
	WAE (40MD)	1400	1000	200	--	--	--	--	--	--	2600
Evaluation	PFT (20MD)	--	--	--	--	250	120	--	250	120	740
(Interim)	WAE (20MD)	--	--	--	350	250	120	350	250	120	1440
Evaluation	PFT (40MD)	--	--	--	--	500	120	--	500	120	1240
(Efficacy)	WAE (40MD)	--	--	--	700	500	150	700	500	150	2700
Post-Spray	PFT (10MD)	--	--	--	--	250	100	--	250	100	700
(Trend)	WAE (20MD)	--	--	--	350	250	100	350	250	100	1400
Total		2100	2625	650	1400	2000	710	1400	2000	710	
F.Y. Total				5375			4110			4110	13595

1/ MD = Man Day. WAE salaries at GS-5 level.

Table 3. Cost estimate for preventive spray pilot test - equipment and materials.

INSECTICIDES			
Sevin-4-oil	25 gals. at $10.00/gal.	$ 250.00	
Dursban	25 gals. at $47.00/gal.	1,175.00	
Lindane	50 gals. at $25.00/gal.	1,250.00	
Fuel oil	1700 gals. at $0.35 gal.	595.00	
Nutri-sol	25 gals. at $1.00/lb.	25.00	
		$ 3,295.00	$ 3,295.00
EQUIPMENT			
1200 metal tags		$ 150.00	
1200 aluminum nails		5.00	
Extension ladder		75.00	
2 - 25' telescopic poles at $120.00/eac.		240.00	
Plastic flagging at $1.00/roll		10.00	
Protective clothing			
3 pr. goggles at $8.00/pr.		24.00	
3 pr. gloves at $7.00/pr.		21.00	
3 respirators at $10.00/ea.		30.00	
3 plastic tarps at $7.00/ea.		21.00	
18 catchment collars at $15.00/ea.		270.00	
1 gross screw top vials at $25.00/gross		25.00	
1 gal. 95% alcohol at $10.00/gal.		10.00	
4 rolls string at $2.00/roll		8.00	
200 wooden stakes at $15.00/100		30.00	
5 Tee Jet nozzles (assortment) at $3.00 ea.		15.00	
Copper tubing and fittings (assortment)		20.00	
6 rolls film and processing at $12.00/roll		72.00	
		$ 1,026.00	$ 1,026.00
SERVICES			
Rental of 100 gal. low-pressure sprayer		$ 250.00	
Lab analyses (100 soil samples) at $50.00/ea.		5,000.00	
		$ 5,250.00	$ 5,250.00
SALARIES AND TRAVEL		$13,595.00	$ 13,595.00
			$ 23,166.00

REFERENCES

Smith, R. H., G. C. Trostle, and W. F. McCambridge. 1975. Protective spray tests for bark beetles in western United States. (Ms. in preparation).

Stipe, L. E. 1975. Biological Evaluation. Mountain pine beetle infestation in the Island Park Campgrounds, 1974. U.S. Forest Service Report (Processed). 3pp.

Swain, K. W. 1965. Protecting ponderosa pine from bark beetle attack by use of a lindane-water emulsion spray. U.S. Forest Service Report. (Memeographed). 13pp.